The Moine Thrust Project

Revisiting Peach and Horne's country

by Maarten Krabbendam

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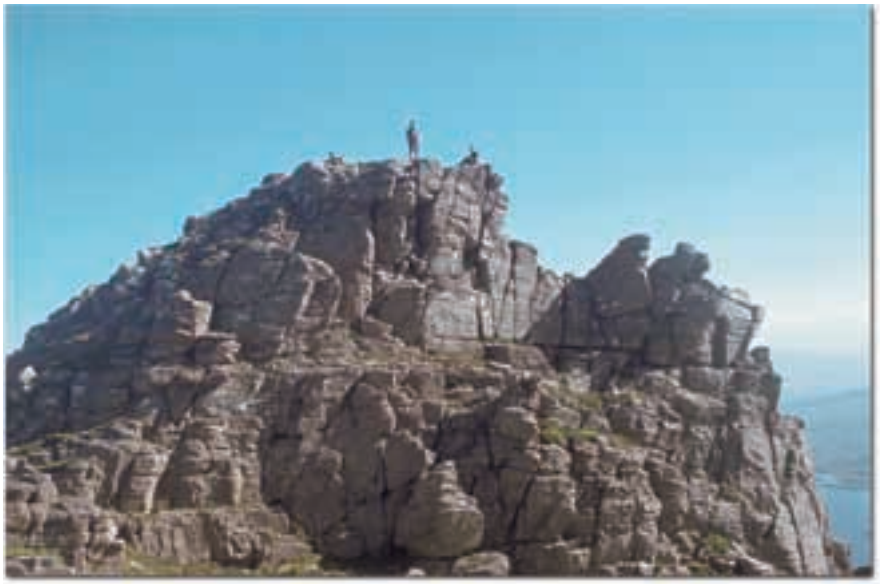
At the close of the nineteenth century, a team of Geological Survey geologists led by Benjamin Peach and John Horne mapped in great detail the entire Moine Thrust Belt, stretching almost 200 kilometres from Durness on the north coast of Scotland to the south point of Skye. In doing so, they put the final nail in the coffin of the Highland Controversy — whether or not the rocks of the Moine had a stratigraphical contact with the underlying Cambro-Ordovician sedimentary rocks, or whether there had been large, westward movement along the Moine Thrust, thrusting the metamorphic Moine rocks over unmetamorphosed rocks. We now know that the Moine Thrust is one of the major structures of the Caledonian Mountain Belt (Ordovician–Silurian in age) and was caused by the collision of Baltica (Scandinavia) and Laurentia ('North America'), which incorporated Scotland at that time.

The Moine Thrust Belt provides some of the best, and certainly most accessible, examples of thrust tectonics anywhere in the world. Every year hundreds of geology students, mainly from the UK but also from abroad, visit the area to hone their skills in geological mapping. Also, the geology in North-West Scotland has very strong links with the wild and spectacular landscape, which lures tourists from around the world. Tourism is now the most important economic activity in many parts of the region.

Despite much academic mapping in the 1960s and 1980s, the geological maps of Peach and Horne have not been updated for over a century and are in need of revision. The BGS has therefore embarked on an eight to ten year project to revise all the map sheets that contain the Moine Thrust — 10 in total. Because of the interesting geology, the project has grown and now has a great number of stakeholders, ranging from BP, via several academic collaborators, to the local visitor centres.

Because the Assynt Special Sheet is the most popular geological map of the region (but also the most complicated!) the Moine Thrust Project team has started here. The Assynt Special Sheet contains the so-called Assynt Window, where the Moine thrust bulges out and contains a series of subsidiary thrusts that all interact with each other in a complex manner. During the past two seasons, the Moine Thrust Project team has, despite very wet weather, carried out fieldwork and revised about 80% of the sheet. This revision uses academic



The castellated ridge of Stac Pollaidh shows deep weathering, which suggests it may have been a nunatak during the last glacial maximum.

mapping, re-evaluates the original survey, and hence targets the actual remapping to small, very specific, 'problem' areas. The revision has led to a re-evaluation of the structure of the Assynt Window. For instance, the famous view of the Glencoul thrust *(right)* has tentatively been reinterpreted to be the Ben More Thrust, thus solving a long-standing problem of the northern termination of that structure.

Quaternary geology

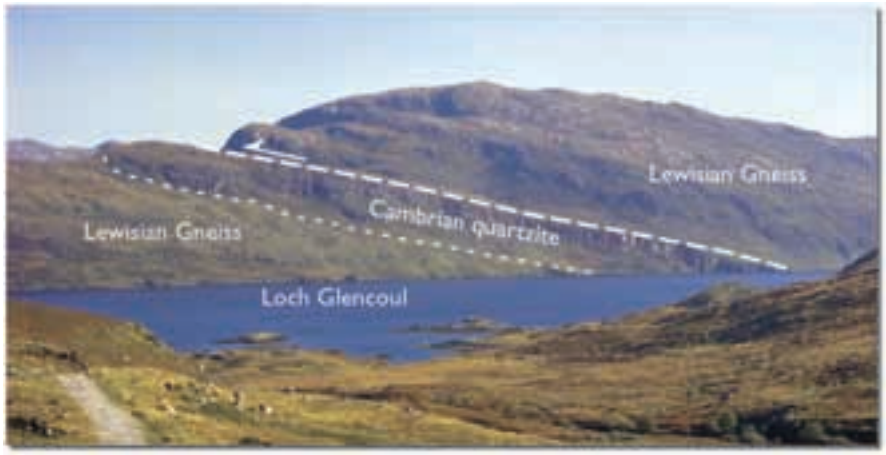
The Quaternary geology has never been mapped systematically in the North-West Highlands. Thus, in addition, the Moine Thrust Project team is completely surveying the Quaternary geology. Preliminary results of the Quaternary studies suggest that the peak of Stac Pollaidh — very popular with hillwalkers — was not covered by glacier ice during the last ice age, implying that the last (Devensian) ice sheet in the area may have been much thinner than previously thought. Map production of Quaternary features is greatly helped by the use of ortho-rectified air photos directly in a geographical information system (GIS) package.

Alkaline intrusive rocks

Within the Assynt Window is a suite of somewhat enigmatic intrusive rocks, part of the so-called North-West Highlands Alkaline Suite, including nepheline-syenite, quartz-syenite, peralkaline rhyolite and even carbonatite — the only occurrence in Britain. As similar rocks elsewhere are commonly associated with rifting, the setting in Assynt, in a zone of crustal shortening, is rather unusual. The various minor intrusions have a clear link with the structure and these rocks have been sampled and are now being dated at the NERC Isotope Geosciences Laboratory. This dating programme is expected to better constrain the age of thrusting.

Academic collaboration

Academic interest in the region is demonstrated by three student projects that are now running and supported, in part, by the BGS's University Collaboration project. Sven Lukas (University of St Andrews) is studying the late glacial evolution of the area. David Cheer (also St Andrews) is tackling the complex structure of the Moine rocks, east of the Moine Thrust. Rob Raine (University of Birmingham) has started a detailed biostratigraphical study of the Cambro-Ordovician sediments. This sedimentary package records the passive margin evolution of the Iapetus Ocean. Correlatives can be found in Newfoundland and in north-east Greenland; however, intense studies in these areas have, until now, outpaced research in the UK and the 'Durness' sequence is, according to Rob's supervisor Paul Smith, 'now less well studied than comparable rocks in Greenland'.



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The Glencoul Thrust (or probably the Ben More Thrust) emplaces Lewisian Gneiss (Archaean) over Cambrian Quartzite, which in turn unconformably overlies Lewisian Gneiss of the Foreland.

Publications for students and hillwalkers

BP has co-funded a number of activities that aim to improve the public understanding of the earth sciences and, indirectly, support the local tourist industry. The Moine Thrust project team is preparing a guide and map to the geology and landscape of Assynt, targeted at hillwalkers, which describes nine walks renowned for their beauty and their geological interest. The guide will be published in spring 2004 *(see back cover)*. In collaboration with Rob Butler from the University of Leeds, a website is being built that will contain a wealth of information on the Moine Thrust and thrusting in general, and will guide the virtual visitor to a real visit. It is also hoped that this will prove a useful resource for geology lecturers and students around the world who use the Moine Thrust as a case study for their structural geology courses. ▮

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